



# ***Engineering in the 21st Century:***

***Skills Engineers Need to Succeed in a  
Competitive Global Market***

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***February, 2000***

## ***Presentation Overview***

- ***Compare the past with today and future***
- ***Discuss current and future market***
  - ***Market trends***
  - ***Market pressures***
- ***Define the “New Engineer”***
- ***Example Projects for the “New Engineer”***

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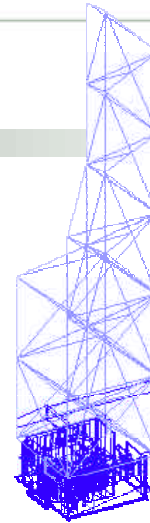
## ***Engineering is faster***



1930s  
– Decade



1970s  
– Months



Today  
– Days/Hours

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Communication formerly relied on phones, faxes and airmail – people were patient

Now phones, video, wireless and satellite networks are increasingly linked and networked.

Electronic delivery is first choice, for non-digital communication overnight delivery is expected – don't expect patience

Empire State Building

1930s                      10 years to Design

World Trade Center

- Reasonable Structural Analysis measured in months using mainframes

Today


An obsolete laptop has more power than 1970s mainframe

Design programs easily work on Desktop PC or server accessed over a network or Internet

Input loadings and have preliminary designs within a day

I.M. Pei's Bank of China building (1982-1990) was built in less time than it took to design the Empire State Building

## ***Comparing the past with the present***

<b><i>The Past</i></b>	<b><i>The Present</i></b>
	
<ul style="list-style-type: none"><li>– <b><i>Local</i></b></li><li>– <b><i>Regulated</i></b></li><li>– <b><i>Public</i></b></li><li>– <b><i>Best product</i></b></li><li>– <b><i>Operability</i></b></li><li>– <b><i>Design to suit</i></b></li><li>– <b><i>Purchase to specification</i></b></li></ul>	<ul style="list-style-type: none"><li>➤ <b><i>Global</i></b></li><li>➤ <b><i>Deregulated</i></b></li><li>➤ <b><i>Private</i></b></li><li>➤ <b><i>Lowest cost</i></b></li><li>➤ <b><i>Time to market</i></b></li><li>➤ <b><i>Standard design</i></b></li><li>➤ <b><i>Standard product</i></b></li></ul>

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PRICE and TIME-TO-MARKET are DRIVERS

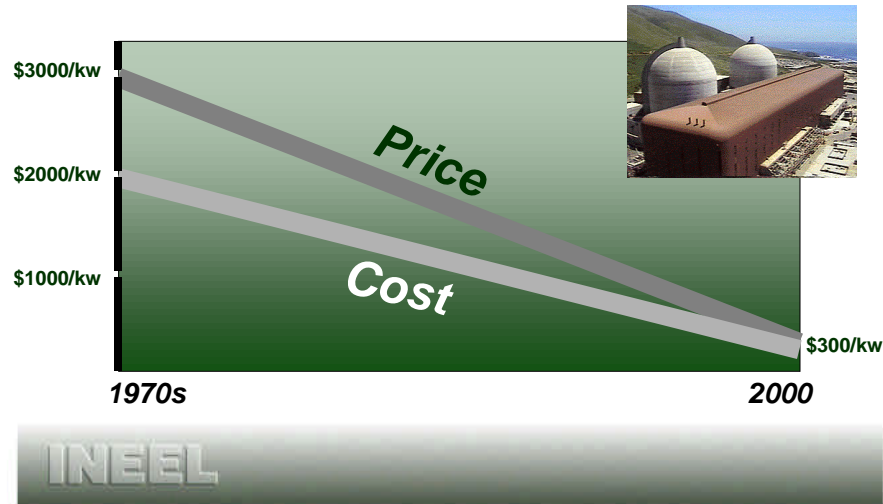
### **Past (when I was young)**

- Local work went to local firms
- Regulated (public utilities, rate commissions)
- Largely public or private regulated monopolies
- Price was not primary (get the best product possible)
- Schedule was not primary (Get it done right)
- Design to suit ( reliability very important)
- Purchase to specification

### **Present (just feel young)**

- Global markets
- Deregulated, not only here but almost all regions of the world
- Largely private (no public utilities)
- Very competitive (price very important)
- Speed (time-to-market win market share, get revenue as soon as possible)
- Standard design (speed)

## ***Power Markets (price/cost)***



Price and time to market have become dominant market forces

Look at power prices.

Early 70's, local, regulated US market,  
\$3000/kw for constructed power

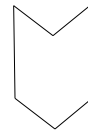
Today in a global, deregulated, private marketplace

\$300/ kw, for constructed power

And you have to get the plant on line in a much shorter time so that the investors can get a rapid return on investment.

## ***Response to Market Forces***

- ***Lower Design Cost***
- ***Lower Equipment Cost***
- ***Lower Construction Cost***
- ***Shorter Schedule***



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The facts of life (\$300/kw) have drastically changed what we do, what we sell and where we do it.

We have to do everything

- ❖ faster and cheaper and
- ❖ compete with firms from anywhere in the world.

Therefore we have to respond with:

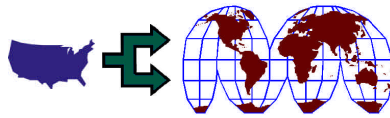
- Lower Design Cost
- Lower Equipment Cost
- Lower Construction Cost
- Shorter Schedule

## **Result**

- ***Lower Profit Margin Requires Increased Volume***



- ***Must Expand Markets***



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Interesting strategic dilemma.

Profit margin goes down, even though you have:

- lowered design cost,
- lowered material cost,

How can your company increase total profits or grow?

A: By greatly expanding its volume. This generally means global expansion.

**Example: American telecom company with**

- **Big U.S. share, but is faced with fierce competition in the U.S.**
- **Profit and market share may no longer grow in the U. S.**
- **Growth, requires expansion to 3<sup>rd</sup> World and overseas markets.**

## ***Industry in global environment***

- ***Cut design cost***
  - *Pre-designed standard configurations*
  - *Modular and standardized designs*
- ***Use low-cost labor***
  - *New Deli versus New York*
- ***Procure low-cost materials***
  - *Bulk deals (reliable vendors)*
  - *Standard products*
  - *Low-cost factories (global sourcing)*

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I think you are getting the idea - so here is a typical project.

Standard design in a center of excellence, maybe in the U.S.,

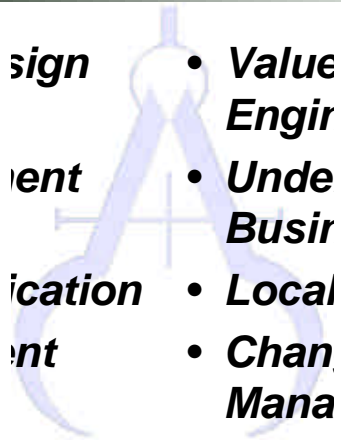
Detail design in New Delhi or Manila,

Materials delivered from anywhere in the world, with the primary market drivers being cost, speed and quality.

Now let's design the Engineer to meet this marketplace.



## **21<sup>st</sup> Century Engineering: Criteria**

- 
- **Value**
  - **Engir**
  - **Unde**
  - **Busir**
  - **Local**
  - **Chan**
  - **Mana**

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## **21<sup>st</sup> Century Engineering: Result**

- **Good Engineer**
- **Diverse Global Environment**
- **Flexible to Live Anywhere**
- **Good Business Sense**
  - *Know your customer*
- **Understand Schedule & Cost Trade-offs (Net Present Value)**
- **Creative**
- **Non-Linear**

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**First and foremost, must be a good engineer**

- **Must be ready to work and live in a diverse global environment**
- **Must be flexible and willing to live and work anywhere in the world; I have lived in 10 places, inside and outside the U.S., and in my business, that's not many.**
- **Must be a very good business person; and must understand the economics of your customer's business and the impact of what you are selling.**
- **Must understand how to use materials to impact cost and schedule; Example; long-term deals with vendors can remove months from the procurement process (writing specs, bidding and negotiating).**
- **Must understand schedule and its impact on net present value.**
- **Must understand speed and time to market, and**
- **Finally, must be able to live in a non-linear changing world.**

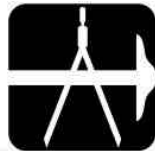
Engineers are often organized, linear thinkers, but linear solutions often take too long and cost too much.

A telecom Customer just wants cheap call minutes in a market place by a fixed date. The engineers job is to deliver the working product on time even when circumstance change. Being Linear won't get you there.

## ***Design***

### ***The Past***

- ***Linear***
- ***Separate Departments***
- ***Handoffs***



### ***The Present***

- ***Cross Functional***
- ***One Project Team***
- ***No Handoffs***



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**Old design** - design used to be a linear process - separate departments with handoffs

- Technical design —> issue to procurement and/or Manufacturing —then released to build or sell

**New design** - is a cross functional process - one team, no handoffs.

- Find a solution that satisfies technical, cost, schedule and value constraints.
- Do real time tradeoffs and value engineering
- Team responsible for delivery of design at a given cost and schedule

### **MUST RESPOND TO CHANGE**

- Customer wants telecomm service to City X, Y and Z and be first in the market.
- Competitive network moves in to City A, B and Z and is scheduled to finish first.
- Engineering Response: Change the direction of the build in order to get to City Z first.
- Not a discussion, just do it without changing cost and schedule.

## ***Typical Global Engineering Projects***

- ***Building a Worldwide Fiber-Optic Network***
  - *99 countries with 101 access points.*
  - *Major suppliers are firms in Europe, Asia and North America.*
  - *Permits and regulations in all countries, countless states, counties, provinces, cities, fishing companies, pipeline companies, railroad companies, etc., just to get right-of-way.*
  - *Coordination requirements for design communication, integrated schedules and coordinating construction activities around the world.*

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## ***Typical Global Engineering Projects***

- ***Building a Power Plant in China***
  - ***Standard design center in Gaithersburg, Maryland***
  - ***Detail design center in New Delhi***
  - ***Construction site is in China***
  - ***Materials coming from the U.S., Europe and Asia***
  - ***Schedule = 21 months from financial closing to operation***

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## ***Idaho Engineering Projects***

- ***Radioactive Waste Treatment Facilities***
  - ***Large Scale (\$100M > \$1B )***
  - ***Issues***
    - ***Safety***
    - ***Regulations & Permits***
    - ***Public and Political Realities***
    - ***Contracts and Funding***

**Safety**



**Compliance**



**Completion**



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Privatized Pit 9 Project

Advanced Mixed Waste  
Treatment Project

High Level Waste Treatment  
and Disposal



## ***Summary – An engineer must be:***

- ***Creative/  
Non-linear***
- ***Change Manager***
- ***Flexible, Global,  
Diverse***
- ***Fast***
  - ***Understand  
Commercial  
Consequences***
- ***Cross Functional***
- ***Good  
Communicator***
- ***Deal with Stress***
  - ***Stay Healthy and  
Have Fun***

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Engineering is not a field for the week at heart.

It is a field for the risk-takers and hard workers.

In the 21<sup>st</sup> Century, it is also a rewarding field full of constant change and fun.